

to nearly 1 inch over the East Fork, was released more slowly by melting during the following week, probably reducing somewhat the crests following, particularly in the East Fork and main White Valleys.

As was true through the entire State, there was a decided increase in the intensity of the rainfall in each of the four periods from north to south over the Wabash-White Basin. In the middle and upper Wabash Valley these amounts totalled well under previous January records at all stations; in the West Fork of White Valley the amounts were for the most part somewhat above previous January records; and over the East Fork of White Valley, the rainfall far exceeded that of any previous January at all stations.

The result of this distribution of rainfall was to produce a series of rises in the middle and upper channels of the Wabash and West Fork of White River, with the main crests occurring comparatively early, from the 16th at Bluffton, Ind., on the Wabash River, to the 19th at Edwardsport, Ind., on West Fork of White River; while the descending water from above and the heavier rainfall below caused a more continuous rise in the East Fork and main White, and the extreme lower Wabash River, to their crests later. At Williams and Shoals, Ind., on the East Fork, the crests occurred on January 25. Below, from Petersburg, Ind., on the White, to New Harmony, Ind., on the Wabash, crests were somewhat earlier—January 21 to January 24—most probably because of the serious breaking of levees in the Decker and Hazleton, Ind., sections. At New Harmony, Ind., on the Wabash River, about 50 miles above confluence with the Ohio, while the crest from upstream water was reached on January 24 and there was a slight fall on the following 2 days, a further rise occurred due to backing water from the Ohio River, the final crest being recorded on January 31.

Advices and warnings were issued frequently during the period to all river and distributing stations, and further distribution, was secured by the two Indianapolis radio stations WIRE and WKBF, and the radio station at Evansville, Ind., WGBF. The several State Police radio stations also assisted materially, not only in distributing the advices issued, but also in gathering data and reporting conditions from areas in which wire communication was interrupted. On numerous occasions the Indianapolis radio stations, particularly WIRE, interrupted their regular programs to send out information and warnings sent out by this office. It was necessary also in securing prompt distribution and in getting information for the Weather Bureau office at Indianapolis to call persons by long distance telephone; and calls by telephone from all parts of the river district were frequent throughout the flood period. \* \* \*

At Decker, Ind., the old gage used by the Weather Bureau until the installation of the gages at Hazleton and Petersburg, Ind., showed the crest of the flood at that place to be 30 feet on January 21. It is 1 foot higher than any crest previously observed (29.0 feet in January 1930) and exceeded by 1.2 feet the crest of the flood of March 1913. There is no doubt, therefore, that the White River in this flood of January 1937 experienced the highest water of record along its whole course. This is further borne out by the excessive flooding in the Hazleton, Ind., area, which necessitated the evacuation of many families and damaged considerably the approaches to the highway bridge on Road No. 41, and did some damage to the bridge itself.

It will be noticed that, while the flood in the main White was without doubt higher than any previously known flood, the stages in the Wabash below at Mount Carmel, Ill., were 4 feet below the 31.0 crest of March 1913. This is due to the fact that there was not so much water upstream in the Wabash channel in this year's flood, as well as to the breaking of levees on the White, which slowed down the rush of water from that stream into the Wabash River.

Damage and loss were very severe in the White section below junction of the forks, and in the extreme lower Wabash stretches, but were only moderate to light in the middle and upper channels of the basin.

## CUMBERLAND RIVER AND TRIBUTARIES

By R. M. WILLIAMSON

Heavy rainfall over the Cumberland River Basin during the night of January 1 averaged approximately 2.50 inches; several stations reported in excess of 4.00 inches. This occurred on a rising river bringing an immediate flood at Celina, Tenn., before 7 a. m. and flood warnings were issued at 8:30 a. m., January 2, for all points from Burnside, Ky., to Nashville, Tenn.

The damage from this flood was comparatively light. However, a second flood was in progress shortly after the middle of the month, much more serious than the first.

The actual crests reached in this second flood are given in the table below for a number of points, and comparison is made with the previous high records. The rank as to highest will drop to fourth place for Celina, Tenn., and third place for Carthage, Tenn.,

if the flood of January 1882 (which occurred before these stations were established) is considered.

Station	Length of record (years)	Crest January 1937	Rank as to highest on record	Previous record	Year
Burnside, Ky.	53	54.3		69.4	1929
Celina, Tenn.	34	53.6	Third	57.1	1926
Carthage, Tenn.	52	54.6	Second	58.7	1926
Nashville, Tenn.	63	53.8	Third	56.2	1927
Clarksville, Tenn.	34	65.5	First	60.0	1927
Eddyville, Ky.	20	76.9	do.	68.5	1927

<sup>1</sup> 57.5, January 1882.

<sup>2</sup> 56.5, January 1882.

<sup>3</sup> 60.6, January 1882.

## OHIO RIVER BELOW THE MOUTH OF THE WABASH; MISSISSIPPI RIVER FROM AND INCLUDING CAPE GIRARDEAU, MO., TO AND INCLUDING NEW MADRID, MO.; TENNESSEE RIVER AND TRIBUTARIES BELOW DECATUR, ALA.

By W. E. BARRON

After several months of comparatively low water, in which some unusually low stages were reached, a general rise began in the Ohio River during the last week of December 1936 and developed within 1 month's time into the greatest flood of record.

The flood was caused almost entirely by excessive rains over the drainage area of the Ohio River and its tributaries, including the three largest, the Wabash, the Cumberland, and the Tennessee Rivers. There was practically no snow on the ground at the beginning of the month and whatever amounts fell subsequently were absorbed in the general rains or floods, and had no particular influence on the stages of the river.

The table shows successively the amount of precipitation at various reporting stations for the periods January 1-10, 11-18, 19-25, together with the totals for the 25 days.

Table showing precipitation in inches by periods: January 1-25, 1937, for selected stations, Cincinnati, Ohio, to New Madrid, Mo. (Daily measurements, 7 a. m. or 8 a. m., seventy-fifth meridian time.)

Station	Jan. 1-10	Jan. 11-18	Jan. 19-25	Total, 25 days
Cincinnati, Ohio	1.70	4.56	7.25	13.51
Louisville, Ky.	3.35	4.94	10.30	18.62
Evansville, Ind.	1.90	5.07	7.34	14.31
Dam No. 48	1.81	5.70	7.81	15.32
Dam No. 49	2.89	5.96	8.43	17.28
Shawneetown, Ill.	3.38	6.36	9.20	18.94
Dam No. 50	3.53	4.00	9.71	17.24
Dam No. 51	3.88	4.53	9.99	18.40
Paducah, Ky.	3.76	2.75	10.64	17.15
Dam No. 52	4.48	3.98	10.87	19.03
Dam No. 53	3.66	5.38	8.55	17.59
Cairo, Ill.	3.33	3.87	7.91	15.11
New Madrid, Mo.	2.82	2.30	8.34	13.46

Rain periods along the Cumberland and Tennessee Rivers coincided roughly with those along the Ohio River. The Cumberland River reached 45.3 feet at Nashville, Tenn., on January 8, then receded to 24.0 feet on January 13, after which the almost daily rains brought the stage to 53.8 feet on January 26. This was an important contributing factor to the flood of the lower Ohio.

Along the Tennessee River the rainfall from December 30, 1936, to January 3, 1937, was 5.60 inches at Chattanooga, Tenn.; 5.73 inches at Guntersville, Ala.; 3.92 inches at Decatur, Ala.; 3.64 inches at Florence, Ala.; 3.07 inches at Riverton, Ala.; 5.44 inches at Savannah, Tenn.; and 1.70 inches at Johnsonville, Tenn. At the same time there were equally as heavy rains on the Elk River, which flows into the Tennessee a few miles above Wheeler Dam, and on the Duck River, which joins the Tennessee 14 miles above Johnsonville, Tenn. The rains and upriver discharges produced 33.0 feet at Chattanooga, Tenn., on January 4; 32 feet at Guntersville, Ala., and 23.2 feet at Decatur, Ala., on January 7; 19.6 feet at Florence, Ala., on January 6; 40.3 feet at Riverton, Ala., on January 7; 40.1 feet at Savannah, Tenn., and 32.0 feet at Johnsonville, Tenn., on January 8. Subsequent rains from January 9 to 25, inclusive, were as follows: Chattanooga, 5.76 inches; Guntersville, 7.50 inches; Decatur, 7.76 inches; Florence, 7.32 inches; Riverton, 5.60 inches; Savannah, 8.55 inches; Johnsonville, 21.97 inches. These rains were so distributed in point of time as to produce two

crests at Chattanooga, 28.5 feet on January 20; 26.8 feet on January 27; and two also at Gunter'sville, 28.0 feet on January 22, and 28.5 feet on January 28. At Decatur, located in the reservoir of Wheeler Dam, the stage was maintained at or above 17 feet until February 6, with a second peak of 23.9 feet on January 25. Resulting crests at the stations in the Cairo district were: 19.2 feet at Florence on January 26; 40.9 feet at Riverton on January 27; 42.2 feet at Savannah on January 27 and 28; and 41.0 feet at Johnsonville on January 25. The last named was much influenced by backwater from the Ohio River at Paducah, Ky. These crests were considerably under previous records. They were probably reduced to some extent by storage in the reservoirs in the upper portion of the Tennessee River.

After the Missouri floodway went into operation, the river at Cairo fell from 58.6 feet on the afternoon of the 25th to 57.9 feet on the morning of the 28th, and then resumed rising at a slower rate as a result of the greater spread of water, a condition which had been anticipated and forecast. The rate of rise decreased materially as far upstream as Paducah, Ky. This decrease was aided by the overbank flooding of the Cache River Basin. Water from the Ohio River backed up Big Bay Creek, whose outlet is 8 miles below Dam No. 51, overtopped the ridge separating it from the Cache Valley, and followed the course of the latter across the northern portions of Massac and Pulaski Counties in Illinois, then cutting across southern Alexander County, entered the Mississippi River some 10 or 12 miles northwest of Cairo. This course is said by historians to have been an abandoned valley of the Ohio River; at that time the united Cumberland and Tennessee Rivers followed the present course of the Ohio from Paducah to Cairo. A range of low hills separates the two basins.

For the three periods shown in the table the average daily precipitation at Cincinnati, Ohio, was 0.17 inch for the first period; 0.57 inch for the second period; 1.04 inches for the third period; at Louisville, Ky., 0.34 inch for the first period; 0.62 inch for the second period; 1.47 inches for the third period; from Evansville, Ind., to Dam No. 49, 0.22 inch for the first period; 0.70 inch for the second period; 1.12 inches for the third period; from Dam No. 50 to Paducah, Ky., 0.37 inch for the first period; 0.47 inch for the second period; 1.44 inches for the third period; from Dam No. 52 to Cairo, Ill., 0.38 inch for the first period; 0.54 inch for the second period; 1.39 inches for the third period.

It will be seen that the precipitation for the last period was considerably heavier than the two preceding periods combined. The daily rate of rise in the river therefore was much greater in the last period, January 19 to 24, than in the preceding period, January 11-18, inclusive: Evansville, Ind., 1.1 as compared to 1.0; Dam No. 48, 1.3 as compared to 1.1; Dam No. 49, 2.1 as compared to 1.1; Dam No. 50, 2.2 as compared to 1.2; Dam No. 51, 1.9 as compared to 1.0; Paducah, Ky. (United States Reservation gage), 1.9 as compared to 0.7; Dam No. 52, 1.8 as compared to 0.7; Dam No. 53, 1.6 as compared to 0.8; Cairo, Ill., 1.5 as compared to 0.9 foot.

Counting from December 30, 1936, the total amounts of rise to the crests, Evansville to Cairo, were as follows: 39.55 feet at Evansville; 43.6 feet at Dam No. 48; 48.9 feet at Dam No. 49; 51.6 feet at Dam No. 50; 46.0 feet at Dam No. 51; 46.6 feet at Dam No. 52; 43.2 feet at Cairo. This interesting bulge from dam no. 49 to Dam No. 50 was due largely to a constriction in the river extending from the mouth of the Saline River in Illinois to below Golconda, Ill., a distance of about 40 miles, through which the river must pass between high hills varying from 1 to 2 miles apart; these hills being an extension of the Ozark uplift. It was in part due to the water from the Wabash River, which reached a crest of 27.0 feet at Mount Carmel, Ill., on January 23, its rise having been stopped short of the expected crest by the breaking of levees along the White River in Indiana, some 20 miles above its mouth near Mount Carmel, Ill.

At the beginning of the rise counting also from December 30, stages were very low in the Mississippi River below Cairo: 8.5 feet at Memphis, Tenn., and 2.6 feet at New Orleans, La. Such a condition produces a rapid current and ordinarily tends to lower the stages reached from Paducah, Ky., to Cairo Ill. The States west of the Mississippi River, drained by the Missouri, White, Arkansas, and Red Rivers had been suffering from drought for the last three seasons, and contributed no water to produce a super flood.

#### MISSISSIPPI RIVER FROM BELOW NEW MADRID, MO.; TO THE MOUTH OF THE WHITE; ST. FRANCIS RIVER AND TRIBUTARIES

By F. W. BRIST

The record-breaking flood of January and February 1937, from Dam No. 26 to Cairo, Ill., on the Ohio River, and from Cairo, Ill., to Natchez, Miss., on the Mississippi River, was inaugurated by heavy rains attending an energetic area of low-barometric pressure central over Kansas City, Mo., on the morning of December 31. On this

date a steady rise began in the Ohio River from Parkersburg, W. Va., to Cairo, Ill., which was uninterrupted at Evansville, Ind., and points below and only briefly at Cincinnati, Ohio, until the crest stages of the flood were reached.

The crest stages reached in the Memphis district were as follows: Memphis, 48.7 feet on the self-recording gage and 50.3 feet on the Beale Street gage, in use by the Weather Bureau in previous high floods, February 10; Helena, Ark., 60.3, February 11.

The crest stage at Memphis was 3.7 feet higher than the highest previous flood, which occurred in 1913, and 4.3 feet higher than the flood of 1927. At Helena, Ark., the crest was 3.5 feet higher than the previous highest flood, which occurred in 1927.

No breaks occurred in the Mississippi levees in this district below the Bessie, Tenn., cut-off and the damage was confined to the overflow between the banks and the levees and in the backwater areas of the lower St. Francis Basin in Arkansas and the tributaries of western Tennessee.

The river at Memphis was above the flood stage, 35 feet on the Beale Street gage, from January 21 to March 1, inclusive, or a total of 40 days. It was above 40 feet from January 24 to February 25, or 33 days. It was thus continuously above a stage of 40 feet during a longer period than in any flood beginning with 1903, except that of 1922, when it was 45 days. At Helena, Ark., it was above 50 feet from January 26 to March 1, or 35 days, being a longer period than that of any flood beginning with 1903, except in 1922 and 1927, when it was 44 days.

The cut-off at Bessie, Tenn., whereby an undetermined but increasing amount of water flowed across a narrow neck of land in a loop of the river, and the delayed flow of water through the Cairo spillway added about 0.67 foot more to the crest at Memphis than was apparently indicated by the combined waters of the upper Mississippi and the Ohio Rivers.

#### MISSISSIPPI RIVER FROM THE MOUTH OF THE WHITE TO THE MOUTH OF THE BIG BLACK; YAZOO AND BIG BLACK RIVERS AND TRIBUTARIES

By R. T. LINDLEY

Including about 765,000 acres flooded by backwater from the Mississippi River, the total acreage overflowed during January and February in Delta counties of Mississippi, embracing the Black and the Sunflower-Tallahatchie-Yazoo Basins, amounted to about 1,533,700 acres. However, it is estimated that only about one-fifth of the area flooded was in cultivation, and the greater part only sparsely inhabited. Also, it should be borne in mind that agricultural activity was practically dormant at the time of this flood and the loss of actual and prospective crops was not great.

A large item of expense was incurred in the evacuation of the region, furnishing subsistence and quarters for the families during the continuance of the flood, and the loss of productive labor.

#### MISSISSIPPI RIVER BELOW THE MOUTH OF THE BIG BLACK; RED RIVER BELOW SHREVEPORT, LA.; OUACHITA AND BLACK RIVERS AND TRIBUTARIES IN LOUISIANA; ATCHAFALAYA RIVER

By W. F. McDONALD

The Bonnet Carre spillway located 23 miles above New Orleans, La., was opened by the United States Engineers late in January, and at maximum discharged over 200,000 cubic feet per second from the river into Lake Pontchartrain. The lowering of the stage at Carrollton gage (New Orleans) is estimated to have been not less than 3 feet due to operation of the spillway.

The State and United States Engineers waged an intensive fight to hold levees. Their efforts were completely successful. Notwithstanding the fact that at Natchez, Miss., a new record stage almost 2 feet above previous records was experienced, there was no levee failure. The Natchez crest stands out as the only instance on the Mississippi River below Helena, Ark., in which a new record stage was established. This local peak at Natchez was undoubtedly due to the action of the 12 cut-offs in the Mississippi River between the mouths of the Arkansas and Red Rivers, which operated to depress stages on the upper reaches affected but produced a new high record at Natchez. Below the latter point, crests on the Mississippi River were from 1.0 to 2.8 feet below the previous records established in 1927, while on the Atchafalaya, the crest was 4.1 feet below the previous record at Simmesport, La.

This pronounced discrepancy in the development of the crest in the Mississippi River at and below Angola, La., as compared with the Atchafalaya River, was due to the very fortunate circumstance that the backwater basin in Louisiana, lying to northward of the